

ABSTRACT

The Evaporative Pattern Casting of a Single Groove Gray Iron Pulley.

Trevor Ramcharan

The Evaporative Pattern Casting (EPC) process is an economical method of producing complex, close-tolerance castings using an expandable polystyrene pattern and unbonded sand. The aims of this study were to investigate the following:

1. The successful use of the existing foundry facilities at the University in the production of a ferrous casting, using the EPC process.
2. The parameters required for a good casting.
3. Obtain data to assist in the prediction of final casting dimensions using locally available polystyrene beads.

Polystyrene patterns were produced initially using an aluminium mold, making allowances for metal shrinkage and machining. The patterns were then glued, gated, covered with a permeable refractory coating and dried. They were then placed in a vented flask, completely surrounded by loose dry silica sand. The sand was compacted in and around the entire surface area of the pattern. The flask was then sealed, a pouring basin placed on top of the

down sprue and a low vacuum applied on pouring of the molten metal. The hot metal vapourised the expandable polystyrene pattern, leaving a metal replica in its place.

Throughout the experiments different combinations of gating types, vibration times, pouring basins, refractory coatings and vacuum pressures were attempted to determine the most suitable process variables that lead to a good casting.

The investigation led to several important findings :

1. Coating thickness range from 1.5 mm to 2.0 mm is satisfactory using a locally made alumina/clay refractory coating of specific gravity 1.540 .
2. The silica sand AFS 60 is suitable for ferrous application.
3. The silica sand and refractory coating must be properly dried to reduce splashing of the metal, leading to poor castings.
4. Soft vacuum pressure 178-254 mm Hg. worked best. Higher vacuum pressure may cause bursting of the coating.
5. Gating calculations using sand casting formulas result in gating too small to make rigid pattern clusters. Gate sizes three to four times the calculated results gave satisfactory results. Gating design must cater for cluster handling, coating and compaction to minimise breakage.

6. Minimal compaction required; 30 seconds - 1 minute compaction for the pulley clusters was adequate.
7. Hardness results were on average 42 on the Rockwell C scale which compared favorably with gray iron sand casting.
8. Roughness measurements show a close correlation between the pattern and finished iron casting. Roughness (R_a) was 5.53-8.6 μm on average. Based on visual inspection the structure of a machined portion appeared good.
9. Shrinkage of the metal was about 1.15% for gray iron which was comparable to figures in the foundry handbooks⁽¹⁾. Shrinkage for the polystyrene pattern was more significant in the first 18 days after molding. Shrinkage for the beads should be measured from the pre-expansion date and not molding date. Shrinkage was approximately 0.014 mm/mm (coarse beads) and 0.024 mm/mm (fine beads) for the initial 18 days, but negligible after this period.
10. Safety precautions are required to ensure that the polystyrene vapours are exhausted and filtered to the atmosphere.

In general, these experiments have shown that the EPC process can be successfully used to produce ferrous castings at the University foundry, thus providing an alternative feasible casting method in our country. Further research on specific areas of interest can result in even more improvements.